

Claims

1. A method of washing and drying a pin of a microarray spotting instrument, comprising:
moving said pin to a given position;
washing said pin while in said given position; and
drying said pin without substantially moving said pin from said given position.
2. The method of Claim 1 wherein moving the pin comprises positioning said pin in a given location in a pin washer/dryer apparatus.
3. The method of Claim 2 wherein said given location comprises a chamber for receiving the pin.
4. The method of Claim 3 wherein said chamber is defined by a tube.
5. The method of Claim 1 wherein washing the pin comprises directing at least one stream of wash fluid at the pin.
6. The method of Claim 5 wherein said stream velocity is approximately 3 m/sec.
7. The method of Claim 5 wherein multiple streams of wash fluid are directed at a tip of said pin.
8. The method of Claim 7 wherein the streams are directed in a swirling pattern.
9. The method of Claim 1 wherein said position comprises a tube interior, and

wherein washing the pin comprises directing a stream of wash fluid at the pin through an aperture in the tube.

10. The method of Claim 9 further comprising applying a vacuum to the tube to draw wash fluid out of the tube and away from a printhead holding the pin while directing the stream of wash fluid at the pin.

11. The method of Claim 1 wherein drying said pin comprises flowing air past said pin.

12. The method of Claim 11 wherein the air is flowed at a speed greater than 20 m/sec.

13. The method of Claim 11 wherein said position comprises a tube interior, and wherein flowing air comprises applying a vacuum to the tube to draw air through the tube.

14. The method of Claim 1 wherein said pin includes a pin tip having a slot reservoir for holding sample material to be deposited on a microarray substrate, and wherein washing the pin comprises directing a stream of wash fluid at the slot reservoir.

15. The method of Claim 1 wherein washing the pin comprises impacting said pin with pulsed streams of wash fluid.

16. The method of Claim 15 wherein washing further comprises at least partially drying said pin between applications of said pulsed streams of wash fluid.

17. The method of Claim 1 wherein drying said pin comprises forcing a gas past said pin.

18. The method of Claim 17 wherein said gas comprises air, said air being of lower humidity than air in an enclosure containing the spotting instrument.

19. An apparatus for washing and drying pins in a microarray spotting instrument, comprising a housing having a structure therein defining a plurality of chambers, each for receiving one of the pins of said spotting instrument, said structure including openings leading to said chambers for flowing wash fluid through the chambers for washing pins therein and flowing a gas through the chambers for drying said pins.

20. The apparatus of Claim 19 wherein said structure comprises a plurality of upstanding tubes arranged in said housing.

21. The apparatus of Claim 20 wherein said openings include at least one wash fluid inlet port in each tube for introducing streams of wash fluid into said chamber.

22. The apparatus of Claim 21 wherein each tube includes multiple wash fluid ports around said tube.

23. The apparatus of Claim 22 wherein said multiple wash fluid ports are oriented to direct wash fluid towards the center of said tube.

24. The apparatus of Claim 22 wherein said multiple wash fluid ports are oriented to direct wash fluid in a direction offset from the center of said tube to generate a

swirling wash flow pattern.

25. The apparatus of Claim 22 wherein said multiple wash fluid ports are oriented to direct wash fluid in an upward direction inside said chamber.
26. The apparatus of Claim 22 wherein said multiple wash fluid ports are oriented to direct wash fluid in a downward direction inside said chamber.
27. The apparatus of Claim 19 further comprising means for supplying wash fluid to said housing.
28. The apparatus of Claim 27 wherein said means for supplying wash fluid comprises an air compressor for providing pressurized wash fluid from a wash fluid container.
29. The apparatus of Claim 27 wherein said means for supplying wash fluid comprises a pump for providing pressurized wash fluid from a wash fluid container.
30. The apparatus of Claim 29 wherein said pump comprises a gear pump.
31. The apparatus of Claim 19 wherein said structure partitions groups of said chambers such that wash fluid can be selectively applied to particular groups of chambers.
32. The apparatus of Claim 31 further comprising at least one selector valve for selectively directing wash fluid to one or more particular groups of chambers.

33. The apparatus of Claim 19 wherein the gas comprises air.
34. The apparatus of Claim 19 further comprising means for flowing the gas across surfaces of pins in said chamber.
35. The apparatus of Claim 34 wherein said means for flowing the gas comprises a vacuum pump for drawing air through said chambers.
36. The apparatus of Claim 19 further comprising a generally sealed enclosure around said apparatus, said enclosure including an inlet port for receiving at least some of the gas from outside said enclosure to be used for drying said pins.
37. The apparatus of Claim 36 further comprising a filter at said inlet port for filtering the gas.
38. The apparatus of Claim 36 further comprising an outlet port in said enclosure for releasing gas used for drying said pins outside said enclosure.
39. The apparatus of Claim 19 further comprising a receptacle for collecting wash fluid and gas from said chambers.
40. The apparatus of Claim 39 wherein said receptacle comprises a vacuum plenum chamber.
41. The apparatus of Claim 39 further comprising a vacuum pump for drawing wash fluid and gas out of said receptacle.

42. The apparatus of Claim 41 further comprising a waste fluid container between said vacuum pump and said receptacle for separating gas from said wash fluid.
43. The apparatus of Claim 19 wherein said structure comprises a plurality of upstanding tubes arranged in said housing with each chamber comprising a tube interior, for each tube said openings comprise at least one wash fluid inlet port in a tube wall and axial end openings at opposite upper and lower axial ends of the tube, said opening at the upper axial end of the tube for receiving a pin tip and gas flow, and said opening at the lower axial end of the tube for discharging wash fluid and gas from said chamber.
44. The apparatus of Claim 43 wherein multiple wash fluid inlet ports are arranged radially around said tube wall.
45. A method of washing pins in a microarray spotting instrument, comprising:
moving the pins to a given position; and
impacting tips of said pins with streams of wash fluid.
46. The method of Claim 45 further comprising drying said pins without substantial movement of said pins from said given position.
47. The method of Claim 46 wherein drying said pins comprises flowing a gas past said pins.
48. The method of Claim 47 wherein said gas comprises air.
49. The method of Claim 47 wherein the gas is flowed at a speed greater than 20

m/sec.

50. The method of Claim 46 wherein moving the pins comprises positioning said pins in a given locations in a pin washer/dryer apparatus.
51. The method of Claim 50 wherein said given locations comprise a plurality of chambers, each for receiving one of said pins.
52. The method of Claim 51 wherein said chambers are defined by an array of upstanding tubes.
53. The method of Claim 45 wherein the streams are directed in a swirling pattern.
54. The method of Claim 45 further comprising applying a vacuum to draw wash fluid away from the pins as the pins are impacted with the streams of wash fluid.
55. The method of Claim 45 wherein said pin tips each have a slot reservoir for holding sample material to be deposited on a microarray substrate, and wherein the streams of wash fluid are directed at the slot reservoirs.
56. The method of Claim 45 wherein impacting the pin tips comprises impacting the pin tips with pulsed streams of wash fluid.
57. The method of Claim 56 further comprising at least partially drying said pins between applications of said pulsed streams of wash fluid.
58. The method of Claim 45 further comprising drying said pins by forcing air

across surfaces of said pins, said air being of lower humidity than air in an enclosure containing the spotting instrument.

59. A microarray spotting instrument comprising:
- a printhead for holding a plurality of pins;
 - a substrate station for holding at least one microarray substrate;
 - a well station for holding sample material to be deposited on said at least one microarray substrate using said printhead;
 - an apparatus for washing and drying the pins comprising a housing having a structure therein defining a plurality of chambers, each for receiving one of said pins, said structure including openings leading to said chambers for flowing wash fluid through the chambers for washing pins therein and flowing a gas through the chambers for drying said pins; and
 - a positioning mechanism for moving said printhead relative to said substrate station, said well station and said apparatus for washing and drying pins.
60. The microarray spotting instrument of Claim 59 wherein said structure in said apparatus comprises a plurality of upstanding tubes arranged in said housing.
61. The microarray spotting instrument of Claim 60 wherein said openings in said apparatus include at least one wash fluid inlet port in each tube for introducing wash fluid into said chambers.
62. The microarray spotting instrument of Claim 61 wherein each tube includes multiple wash fluid ports around said tube.
63. The microarray spotting instrument of Claim 62 wherein said multiple wash

fluid ports are oriented to direct wash fluid towards the center of said tube.

64. The microarray spotting instrument of Claim 62 wherein said multiple wash fluid ports are oriented to direct wash fluid in a direction offset from the center of said tube to generate a swirling wash flow pattern.

65. The microarray spotting instrument of Claim 62 wherein said multiple wash fluid ports are oriented to direct wash fluid in an upward direction inside said chamber.

66. The microarray spotting instrument of Claim 62 wherein said multiple wash fluid ports are oriented to direct wash fluid in a downward direction inside said chamber.

67. The microarray spotting instrument of Claim 59 wherein said apparatus further comprises means for supplying wash fluid to said housing.

68. The microarray spotting instrument of Claim 67 wherein said means for supplying wash fluid comprises an air compressor for providing pressurized wash fluid from a wash fluid container.

69. The microarray spotting instrument of Claim 67 wherein said means for supplying wash fluid comprises a pump for providing pressurized wash fluid from a wash fluid container.

70. The microarray spotting instrument of Claim 69 wherein said pump comprises a peristaltic pump.

71. The microarray spotting instrument of Claim 59 wherein said structure in said apparatus partitions groups of said chambers such that wash fluid can be selectively applied to particular groups of chambers.
72. The microarray spotting instrument of Claim 71 wherein the apparatus further comprises at least one selector valve for selectively directing wash fluid to one or more particular groups of chambers.
73. The microarray spotting instrument of Claim 59 wherein the apparatus further comprises means for flowing gas across surfaces of pins in said chambers.
74. The microarray spotting instrument of Claim 73 wherein said means for flowing gas comprises a vacuum pump for drawing gas through said chambers.
75. The microarray spotting instrument of Claim 59 further comprising a generally sealed enclosure around said instrument, said enclosure including an inlet port for introducing gas outside said enclosure into said apparatus for drying said pins.
76. The microarray spotting instrument of Claim 75 further comprising a filter at said inlet port for filtering the gas.
77. The microarray spotting instrument of Claim 76 further comprising an outlet port in said enclosure for releasing gas used for drying said pins outside said enclosure.
78. The microarray spotting instrument of Claim 59 wherein said apparatus further

comprises a receptacle for collecting wash fluid and gas from said chambers.

79. The microarray spotting instrument of Claim 78 wherein said receptacle comprises a vacuum plenum chamber.

80. The microarray spotting instrument of Claim 78 further comprising a vacuum pump for drawing wash fluid and gas out of said receptacle.

81. The microarray spotting instrument of Claim 80 further comprising a waste fluid container between said vacuum pump and said receptacle for separating gas from said wash fluid.

82. The microarray spotting instrument of Claim 59 wherein said structure of said apparatus comprises a plurality of upstanding tubes arranged in said housing with each chamber comprising a tube interior, for each tube said openings comprise at least one wash fluid inlet port in a tube wall and axial end openings at opposite upper and lower axial ends of the tube, said opening at the upper axial end of the tube for receiving a pin tip and gas flow, and said opening at the lower axial end of the tube for discharging wash fluid and gas from said chamber.

83. The microarray spotting instrument of Claim 82 wherein multiple wash fluid inlet ports are arranged radially around said tube wall.

84. A method of using a microarray spotting instrument, comprising:

(a) dipping tips of pins mounted in the pinhead into a reservoir of target material;

(b) positioning the printhead over a microarray substrate to be spotted;

- (c) lowering the printhead to bring the tips of the pins into contact with the substrate to print spots on the substrate;
- (d) raising the printhead to separate the pins from the substrate;
- (e) moving the printhead to position at least a portion of the pins in a washer/dryer apparatus;
- (f) washing the pins; and
- (g) drying the pins without substantial movement of said pins relative to the washer/dryer apparatus.

85. A method of using a microarray spotting instrument, comprising:

- (a) dipping tips of pins mounted in the pinhead into a reservoir of target material;
- (b) positioning the printhead over a microarray substrate to be spotted;
- (c) lowering the printhead to bring the tips of the pins into contact with the substrate to print spots on the substrate;
- (d) raising the printhead to separate the pins from the substrate;
- (e) moving the printhead to position at least a portion of the pins in a washer/dryer apparatus;
- (f) washing said pins by impacting tips of said pins with streams of wash fluid; and
- (g) drying said pins.

86. A method of using a microarray spotting instrument, comprising:

- (a) dipping tips of pins mounted in the pinhead into a reservoir of target material;
- (b) positioning the printhead over a microarray substrate to be spotted;
- (c) lowering the printhead to bring the tips of the pins into contact with the

substrate to print spots on the substrate;

- (d) raising the printhead to separate the pins from the substrate;
- (e) moving the printhead to position at least a portion of the pins in a washer/dryer apparatus;
- (f) washing said pins; and
- (g) drying said pins with gas introduced from outside an enclosure containing said microarray spotting instrument.

87. The method of Claim 86 wherein said gas comprises air.

88. The method of Claim 86 wherein said gas comprises nitrogen.

89. The method of claim 86 wherein (g) comprises flowing the gas over pin surfaces at gas velocities greater than 20 m/sec.

90. A microarray spotting instrument comprising:

- a printhead for holding a plurality of pins;
- a substrate station for holding at least one microarray substrate;
- a well station for holding sample material to be deposited on said at least one microarray substrate using said printhead;
- an apparatus for washing and drying the pins;
- a positioning mechanism for moving said printhead relative to said substrate station, said well station and said apparatus for washing and drying pins; and
- an enclosure containing said printhead, substrate station, well station, apparatus for washing and drying, and positioning mechanism, said enclosure including an inlet port connected to said apparatus for introducing gas from outside said enclosure for use in drying said pins, said enclosure also including an outlet port connected to said

apparatus for discharging the gas.

91. The microarray spotting instrument of Claim 90 wherein said gas comprises air.

92. The microarray spotting instrument of Claim 90 wherein said gas comprises nitrogen.

93. The microarray spotting instrument of Claim 90 wherein said apparatus flows the gas over pin surfaces for drying said pins at gas velocities greater than 20 m/sec.

94. An apparatus for washing and drying pins in a microarray spotting instrument, comprising:

a housing having a structure therein defining a plurality of chambers, each for receiving one of the pins of said spotting instrument, said structure including openings leading to said chambers for flowing wash fluid and gas through the chambers for washing and drying pins therein; and

a device for applying a vacuum to said chambers for evacuating the wash fluid and gas from said chambers.

95. The apparatus of Claim 94 wherein said device comprises a vacuum pump.

96. A method of washing pins in a microarray spotting instrument, comprising:
moving the pins to a given position;

impacting said pins with streams of wash fluid; and

flowing gas past said pins while impacting said pins with wash fluid to increase turbulence to assist in removal of residual sample from said pins.

97. The method of Claim 96 wherein said gas imparts tangential velocity to the wash fluid on pin surfaces to increase effectiveness of said washing.
98. The method of Claim 96 further comprising slightly reciprocating said pins while being washed.
99. The method of Claim 1 further comprising slightly reciprocating said pin while being washed.
100. The method of Claim 1 further comprising slightly reciprocating said pin while being dried.
101. The method of Claim 45 further comprising slightly reciprocating said pins while being impacted with wash fluid.